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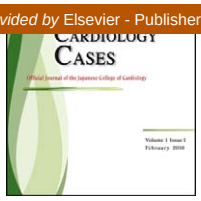

Case Report

Recurrent very late thrombosis of drug-eluting stent: Optical coherence tomography findings

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Summary Very late stent thrombosis (VLST) after implantation of a drug-eluting stent (DES) is a rare but catastrophic complication and the mechanisms are not completely understood. We describe a 76-year-old patient with recurrent VLST of DES that developed at 13 and 23 months after the initial catheter procedure of DES implantation under the cessation of dual antiplatelet therapy. Optical coherence tomography (OCT) observation revealed small stent area of a DES. Based on the OCT findings, balloon angioplasty for expansion of the DES was performed and angiographic Thrombolysis In Myocardial Infarction grade 3 flow was subsequently obtained. Small stent area is considered a significant factor in acute or subacute stent thrombosis according to previous reports. The present report shows that small stent area of DES may be regarded as a key factor in recurrent VLST as well as cessation of dual antiplatelet therapy.

Introduction

Drug-eluting stents (DESs) are widely applied to reduce in-stent restenosis and target lesion revascularization compared with bare metal stents (BMS). However, very late stent thrombosis (VLST) occurring >1 year after stent implantation is associated with delayed healing and subsequent lack of endothelialization and has become a major clinical concern [1,2] because VLST frequently portends serious cardiac events such as sudden death and acute myocardial infarction. The mechanism of VLST of DES may be multi-factorial, and two important mechanisms are cessation of dual antiplatelet therapy (DAT) and incomplete stent apposition (ISA), including late acquired ISA [3–6]. Few case reports have described recurrent VLST of DES [7,8], and possible causes include the cessation of DAT and ISA accompanied by delayed endothelialization. However, the present report describes a patient in which recurrent

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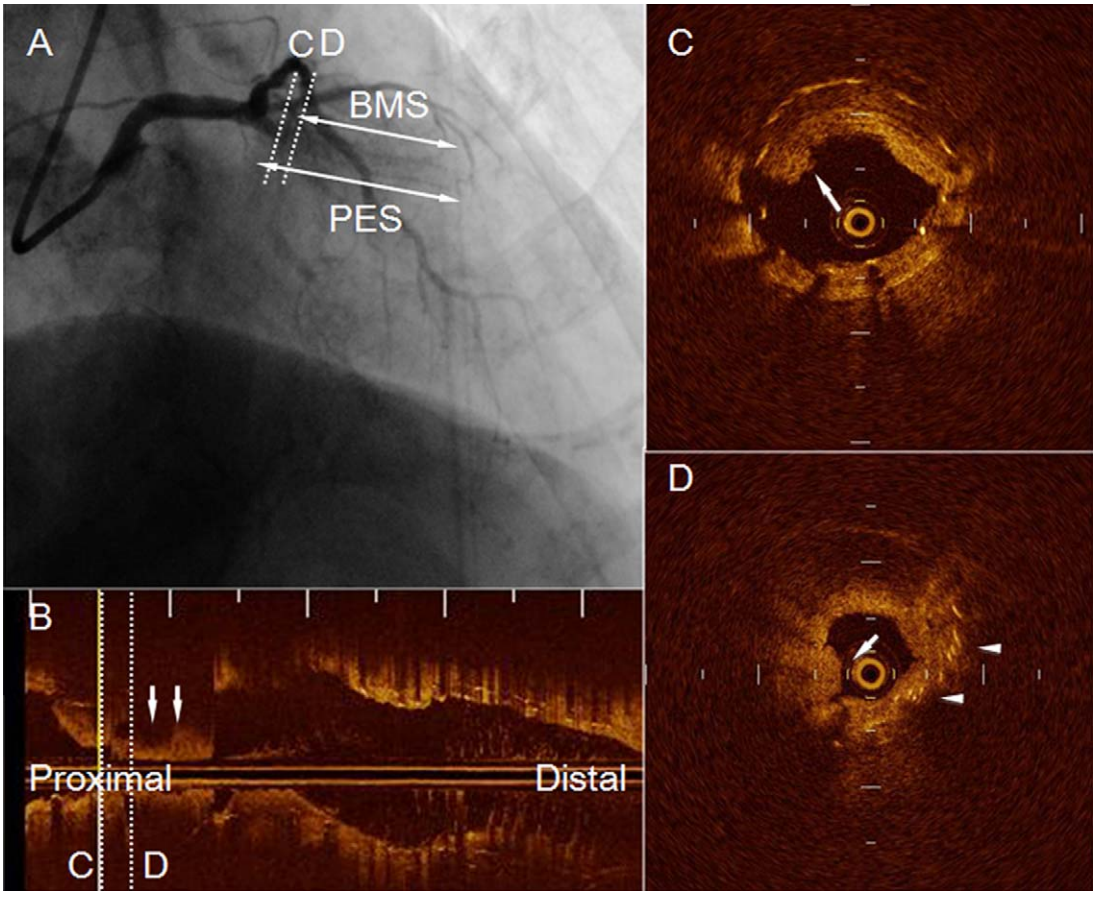

Figure 1 Angiographic and optical coherence tomography (OCT) findings of recurrent thrombotic occlusion of a paclitaxel-eluting stent (PES). (A) Coronary angiograms show total occlusion at the proximal edge of the stent in the left anterior descending artery. (B) Massive thrombotic lesion (arrows) on longitudinal OCT image. (C) and (D) Cross-sectional OCT images also indicate protruding thrombus (arrows) and obvious small stent area (arrowheads). Although thrombus interfered with OCT measurements, measurable minimal stent area was 2.23 mm^2. BMS, bare metal stent.

VLST of DES was caused by cessation of DAT and small stent area that was confirmed by findings of optical coherence tomography (OCT).

Case report

A 76-year-old man with hypertension and dyslipidemia was admitted to our hospital with severe chest pain on August 7th 2009. He had previously undergone percutaneous coronary intervention (PCI) three times due to ischemic heart disease at a local community hospital. The first PCI comprised BMS (Liberte® 3.0 mm × 24 mm; Boston Scientific, Natick, MA, USA) implantation into the proximal left anterior descending artery (LAD) for unstable angina pectoris in June 2007. The second was implantation with a paclitaxel-eluting stent (PES; Taxus-Express2® 3.0 mm × 28 mm; Boston

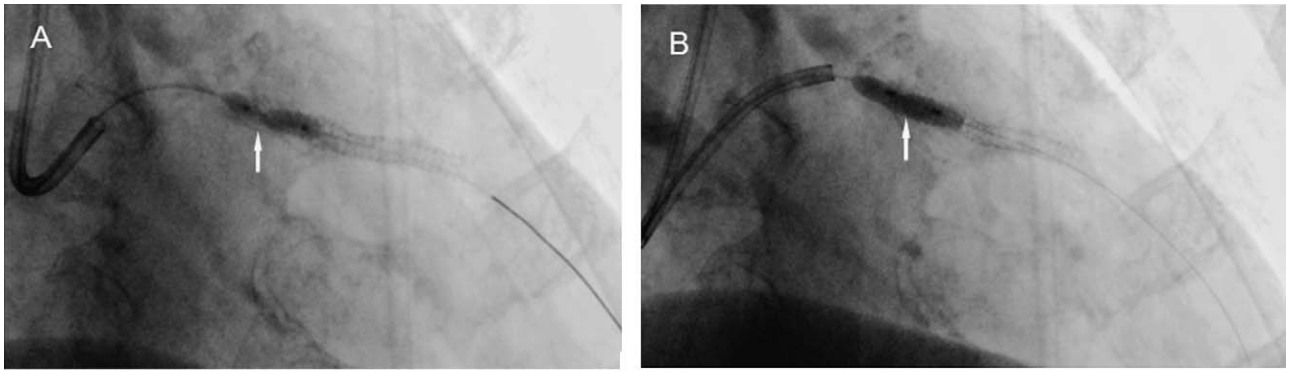

Figure 2 Fluoroscopic images during balloon angioplasty. (A) Non-compliant balloon (3.25 mm × 12 mm) inflated at 20 atm remains indented (arrow). (B) Indentation has disappeared after high-pressure (30 atm) inflation (arrow).

Scientific) for BMS restenosis in September 2007 under aspirin (100 mg/day) and clopidogrel (75 mg/day) administration. BMS was completely covered by PES. The third PCI was balloon angioplasty for a diagnosis of ST elevation myocardial infarction (STEMI) due to VLST of PES in October 2008, 3 days after clopidogrel discontinuation.

He was admitted to the same hospital 23 months (August 6th 2009) after PES implantation (2nd PCI) because of melena due to colonic diverticulitis. DAT was discontinued after admission and STEMI occurred again on the following day, when he was transferred from that hospital to our institution. Coronary angiography revealed total occlusion at the proximal edge of the PES in the proximal LAD, and recurrent VLST of the PES was documented. Massive thrombus inside the PES and obvious small lumen area of the PES were identified by OCT (ImageWire®, LightLab Imaging, Westford, MA, USA). OCT images indicated small stent area with uncovered struts and measurable minimal stent area was 2.23 mm^2, despite the fact that thrombus with backscattering interfered with precise measurements for stent area (Fig. 1). Although intracoronary thrombectomy was attempted before OCT procedure, a thrombectomy catheter did not pass through the stent because small stent area possibly disturbed its delivery. Balloon angioplasty with a non-compliant balloon (Quantum Maverick® 3.25 mm × 12 mm; Boston Scientific) was performed after thrombectomy. The balloon was firstly inflated at 20 atm to dilate the stent, but the balloon remained indented. Thereafter, the balloon was inflated at 30 atm over the rated burst pressure (Fig. 2). This strategy resulted in optimal PES expansion on OCT images and TIMI grade 3 flow on angiography (Fig. 3). The patient was discharged on day 15 without major adverse cardiac events, and the clinical course of the patient was uneventful without taking aspirin.

Discussion

This is the first report to show the mechanisms of recurrent VLST of DES based on OCT findings of obvious small stent area. In this case, the leading mechanism of recurrent VLST of DES is cessation of DAT, and small stent area also contributes to repeat VLST. It was speculated that stent underexpansion occurred at the 2nd PCI (PES implantation), although there were no available data on IVUS or OCT during the procedures of 1st, 2nd, and 3rd PCI because they were performed at another institution.

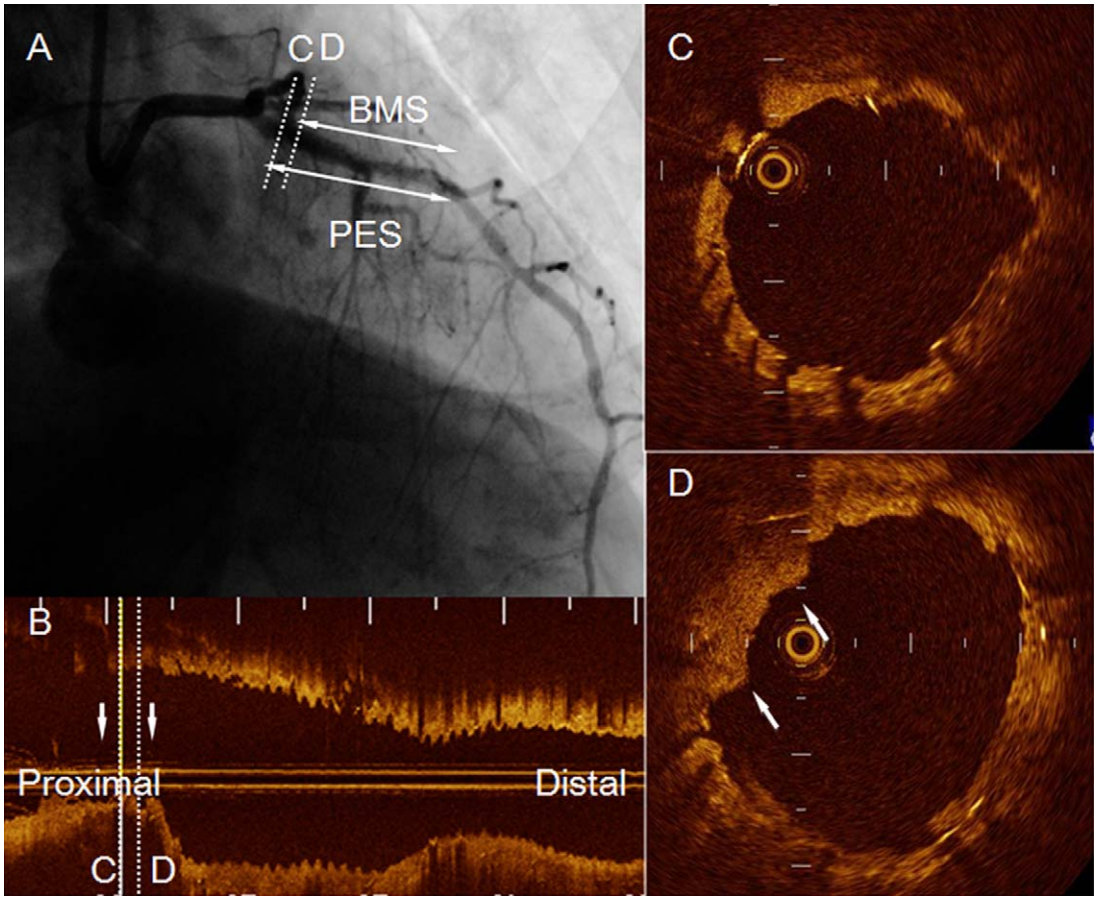

Figure 3 Angiographic and optical coherence tomography (OCT) findings after balloon angioplasty. (A) Angiograms show Thrombolysis In Myocardial Infarction grade 3 flow without filling defects. (B) Lumen dilation at proximal edge of stent (arrows) evident on longitudinal OCT image. (C) and (D) Cross-sectional OCT images show optimal stent expansion (minimal stent area, 5.43 mm^2) despite protrusion mass with signal attenuation suspected mural thrombus (arrows). BMS, bare metal stent; PES, paclitaxel-eluting stent.

Stent thrombosis is classified according to elapsed time after stent implantation as acute (within 24 h), subacute (1—30 days later), late (LST; 30 days to 1 year later), and very late (VLST; >1 year later) [9]. The incidence of VLST is slightly higher for DES than for BMS because of delayed neointimal healing and endothelialization associated with DES [1,2]. Accumulated findings emphasize that the mechanisms of stent thrombosis are multi-factorial, such as the discontinuation of DAT [10,11], stent underexpansion [12,13], ISA [3—6], bifurcation stenting [10,11], and low ejection fraction of the left ventricle [10]. ISA is the most important cause, especially of VLST of DES because it results in delayed arterial healing after DES implantation [3—6]. Although there have not been many reports of recurrent VLST of DES [7,8], discontinuation of DAT and ISA are recognized causes of recurrent VLST [7,8].

Discontinuing the antiplatelet therapy was one trigger of the VLST of PES in the present patient. Clopidogrel was interrupted at the first stent thrombosis, and DAT was discontinued before the second episode. An additional cause was small stent area, which was clearly revealed by the OCT examination and is a known cause of acute and subacute stent thrombosis [12]. Nevertheless, small stent area can lead to recurrent VLST of DES under conditions of delayed endothelialization or incomplete neointimal healing. Although small lumen area of BMS can lead to restenosis accompanied by neointimal healing that may occur at over 30 days after stenting, VLST might not arise from small lumen area of BMS. Therefore, we speculated that the combination of small stent area, delayed arterial healing characterized by subsequent DES deployment, and discontinuation of antiplatelet therapy foreshadowed the recurrent VLST in the present patient. Aggressive stent expansion might not be necessary for DES due to lower late loss compared with BMS, but obvious DES underexpansion is one important factor involved in VLST. The present case is not serial but single point of OCT observation. Therefore, there was a limitation to clarify previous status of the implanted DES for treatment of BMS restenosis, although we speculate the cause of small PES lumen area was stent underexpansion. For this patient, restudy using OCT has not been achieved because of no evident myocardial ischemia. Finally, the current OCT images suggest that optimal expansion of an implanted DES is required to prevent VLST. In addition, we should take care to interrupt DAT especially in cases of the underexpansion of DES.

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